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SMALL RUMINANT PRODUCTION SYSTEMS

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ABSTRACT

Small ruminant production systems in South and South East Asia and the South Pacific are primarily traditional systems. These can be classified into three main systems :

- i) Extensive systems,
- ii) Systems combining arable cropping to include :
 - a) roadside, communal and arable grazing systems,
 - b) tethering
 - c) cut-and carry systems, and
- iii) Systems integrated with tree cropping.

Of these, the systems integrated with tree cropping have not been exploited and therefore represent a great potential. Within the production systems there exist 53.4% and 22.9% of the total population of goats and sheep in Asia respectively, which have annual growth rates of 1-2%. The per caput goat meat supply is decreasing while that of mutton is increasing. The value of ownership of these species is reflected in several advantages and include income, food, security, employment, fertiliser, social values, recreation and by-product feed utilisation. The traditional nature of these systems is due to the secondary position of goats and sheep in mixed small farm systems, lack of incentives and new innovations that do not stimulate production. The major constraints to the production systems are inefficient use of the goat and sheep genetic resources, management, diseases and health, and inadequate marketing outlets. This trend if left uncorrected, is likely to continue. Potential improvements to the production systems, including the need for appropriate methodology, are therefore urgently necessary which can make a significant and rapid impact on production. Expanding production from both species calls for major shifts in resource use and especially new innovations that are demonstrably more superior and consistently profitable.

I INTRODUCTION

Ruminant production throughout Asia and the South Pacific is presently one of focus and priority in livestock development programmes. There are three principal reasons for this. Firstly, relative to the contribution by crops, ruminants have failed to keep pace with the increasing demand by humans, of food of animal origin. Secondly, compared to the larger, very intensive and more successful non-ruminant pig and poultry industries found in urban-fringe areas, ruminants, with few exceptions, have not hitherto demonstrated a parallel success. Thirdly, there is the important point that among ruminants, goats and sheep traditionally owned and serve a wide variety of functions in the preponderance of small farm systems that are characteristic of Asian agriculture involving several millions of small farmers, landless labourers and peasants in essentially rural areas (Devendra, 1983). In cognisance of these reasons, it is appropriate to examine the nature of the production systems in the context of current and future contribution.

Small ruminant production systems form a component of farming systems (Duckham and Masefield, 1970; Ruthenberg, 1976, Spalding, 1979). While agro-ecological conditions determine the types of crops and livestock systems suitable to any one location, the prevailing ruminant production systems have evolved in response to the total availability of land, the type of crop production practiced, the frequency of cropping, the area of uncultivated waste land and the density of animal populations.

Within the developing countries, present small ruminant production systems are primarily traditional. Part of the reasons for this is because goats and sheep play a secondary role to crop production, have not received adequate research and development support and are generally of low priority in animal production programmes. A recent report (World Bank, 1983) for example, concluded from an analysis of 80 research and/or development projects on a regional basis, that there was a lack of support within the developing countries, inter-national donor and lending agencies. Equally important, there has been limited change and improvements to evolve

more efficient productive systems. In turn this has resulted in very limited or no major shift towards the development of commercial production systems that are consistent with increased productivity.

The fact remains however, that small ruminants play an important and contributory role to the stability of complex small farm systems such as those found in Asia (Devendra, 1976, 1983). Attempts to improve the prevailing systems must necessitate a better understanding of the components of the production systems, the present limitations, potentially feasible improvements and the opportunities to evolve more productive systems. This paper examines and discusses these aspects.

II GOAT AND SHEEP POPULATIONS

Table 1 indicates that goats and sheep account for 53.4% and 22.9% of the total population of these species in Asia. The ratio of sheep to goats is 1:1.8. The rates of growth of the individual species over the last 10 years from 1974-76 to 1984 were 2.1% and 1.5%, indicating that the goat population is growing faster than the sheep population in South and South East Asia and the South Pacific.

(Table 1 here)

Table 2 sets out the corresponding magnitude and relative contribution of the products from goats (meat, milk and skins) and sheep (mutton, milk, skins and wool). Goats produced 54.1, 53.8 and 57.6% of the total production of meat, milk and skins in Asia respectively. Likewise, sheep produced 19.8, 1.4, 20.8 and 19.7% of the total production of mutton, milk, skins and wool respectively in Asia.

(Table 2 here)

III GOAT AND SHEEP GENETIC RESOURCES

Table 3 demonstrates that over the three periods 1961-65, 1974 and 1984, the percentage proportion of carcass meat accounted for by goat meat was about 3.9% and 5.6% for mutton in the last decade. The per caput goat meat supply suggests that this is generally static (0.40-0.47 kg/annum), and for mutton on the increase (0.56-0.64 kg/annum).

(Table 3 here)

Table 4 identifies and summarises the names of the more important goat breeds in South and South East Asia and the South Pacific. While 12 "improver" breeds are identified, this list is by no means complete. Each of these breeds has a speciality and the approximate adult live weight of the doe is also given. A number of these breeds like the Jamnapari, Beetal and Marwari in India, and Damani, Dera Din Panah, and Kamori in Pakistan are dairy breeds. However, there have been very little or no selection for improved milk yields with all these breeds. Thus, their potential milk yielding capacity is not very certain. The Fijian and Sirohi are outstanding meat breeds and respond to good live weight gains in efficient feeding systems. The Black Bengal and Malabar breeds from India and the Katjang from Malaysia are prolific breeds, but yet again there has been no selection for this trait. The Barbari is a dual or triple-purpose breed which has considerable potential for use in development programmes.

(Table 4 here)

Similarly, table 5 summarises the names of the more important sheep breeds in South and South East Asia and the South Pacific. Ten breeds are identified of which the Nellore and Mandya from India and the Baluchi from Pakistan are good mutton breeds. With the exception of the Lohi breed in India, Indonesia has at least three outstanding breeds in the Javanese thin tailed, Priangan and East Java fat tailed goats. Although high variability in litter size has been noted, there are indications of a high repeatability of ovulation rate and a "Boorola" type (Bradford et al., 1984). These breeds are particularly valuable for improvement programmes and also in the multiplication of numbers. Two useful breeds for coarse wool production are the Chokla from India and the indigenous sheep in Malaysia (Devendra, 1975). The sheep and goat breeds of India have recently been described by Acharya (1982) and of Pakistan by Hasnain (1985).

(Table 5 here)

IV ECONOMIC IMPORTANCE OF GOATS AND SHEEP

An indication of the economic importance of rearing goats and sheep is found in detailed studies on the subject recently reported in Indonesia (Knipscheer et al., 1983). This study indicated that the

involvement of rural households in West Java in raising small ruminants is large, that one out of every five farmers keeps sheep or goats, and participation by farmers can be as high as 30%. The estimated share of small ruminant income of the total income is indicated in Table 6. The contribution of the goat and sheep enterprise in the total farming income is substantial and was about 14, 17 and 26% for the three categories of lowland, upland and rubber plantation situations, respectively. The report also indicated that the income share of the small ruminant enterprise increased as the farmer's resource base, especially land, decreased.

(Table 6 here)

V SIGNIFICANCE OF OWNERSHIP

Goats and sheep are raised with several objectives in mind. They serve the material, cultural and recreational needs of the farmers. Their ownership has the following advantages :

- (i) Income - important means of earning supplementary income.
- (ii) Food - provide animal proteins (milk and meat) that are important for the nutritional well-being of peasants.
- (iii) Security - sources of investment, security and stability.
- (iv) Employment - creation of employment including effective utilisation of unpaid family labour.
- (v) Fertiliser - contribution to farm fertility by the return of dung and urine.
- (vi) By-product utilisation - they enable economic utilisation of non-marketable crop residues.
- (vii) Social values - the ownership of animals has been shown to increase cohesiveness in village activities.
- (viii) Recreation - socio-economic impact of animal ownership also includes a recreational contribution to small farmers.

The small size of small ruminants is a distinct advantage in the complexity of small farm systems. There are definite economic, managerial and biological advantages as follows:

- (a) Economic : low individual values means a small initial investment and correspondingly small risk of loss by individual deaths. This makes goats and sheep an attractive proposition for household use and subsistence farming, especially for poor families.
- (b) Managerial : goats and sheep can conveniently be cared for by women and children, occupy little housing space, and supply both meat and milk in quantities suitable for immediate family consumption, which is important in view of the difficulties of storage in the tropics.
- (c) Biological : one or two goats or sheep can be kept when nutrition is inadequate for even one cow.

VI PRODUCTION SYSTEMS

Small ruminant production systems in South, South East Asia and the South Pacific have endured in relation to the overall pattern of crop production and farming systems. They are especially dependent on the agro-ecological environment and as ruminants, must always depend on vegetation or crops for their feed base. The reference to the agro-ecological environment is important since in the more arid regions, the sparse vegetation provides a weak feed resource base. For this reason, the small ruminant production systems are primarily nomadic and transhumant systems.

By comparison in the humid tropics, which is characteristic of South India and most parts of South East Asia, feed resources are more abundant and hence sedentary systems which can also be intensive systems become possible. This also enables the more important crop and livestock systems to develop.

Table 6 attempts to bring together types and characteristics of predominant farm systems involving ruminants including goats and sheep in Asia. The table identifies the cropping pattern (wheat, rice, maize or combination of these, coconuts, oil palm and rubber), type of ruminants reared, production objective and also gives approximate sizes of goat and sheep flocks. The latter are variable and partly dependent on the nature and extent of the crop residues produced. Where mixed cropping is involved, the table also provides the types of crop grown. The last column in table 7 gives an indication of the current importance of goats and sheep in each of the main systems, based on average ownership by small farms, landless labourers and peasants. Asian livestock production and management systems have recently been described (Camoens, 1985).

(Table 7 here)

Small ruminant production systems can be classified as follows :

- 1) Extensive Systems
- 2) Systems Combining Arable Cropping
 - i) Roadside, communal and arable grazing systems
 - ii) Tethering
 - iii) Cut-and-carry feeding
- 3) Systems Integrated With Tree Cropping.

1. Extensive Systems

This system is by far the most common for all ruminants throughout the Asian region. It is characterised by small ruminants, usually owned by small farmers, grazing on all available grazing areas, largely uncultivated, including marginal land, for varying periods during the day. The length of the grazing period is dictated largely by the type of ruminant and the objectives of production : meat or milk.

The system has certain very definite features. Rearing ruminants is secondary to crop production, consistent with the pattern of agriculture. Usually, more animals tend to be carried than in the intensive system, probably because of the fact that these animals have access to plenty of grazing land. Buffaloes and cattle tend to be grazed separately, but where goats and sheep are reared, these small ruminants are grazed together probably because goats tend to lead the herd. Additionally, the small ruminants tend to be herded over longer distances compared to buffaloes and cattle which are relatively more sedentary.

The flock sizes are larger (1-15 head) and animals, often goats and sheep belonging to several owners are run together and brought back in the evening. Stocking rates are usually in the range of 1-4 head/ha. Very extensive systems are rare, as with other parts of the humid tropics, presumably because of the availability of more forage and also crop residues.

In the extensive system, a low level of unpaid family income represents the main input. By implication, the use of this unpaid family labour, usually women and children, represents an aspect of effective labour use whereby both cropping and also rearing of ruminants represent important components of farm income. Except for the use of this low labour input, the system is principally one of low resource use, and a generally low level of productivity emerges from sub-standard nutritional management whereby very little or no concentrates, salt or mineral licks are provided, except in the case of dairy cows.

2. Systems Combining Arable Cropping

Ruminant production systems combining arable cropping have evolved in situations where crop production is important to contribute to the stability of the system. Animals do not compete

for the same land and play a supplementary role to arable cropping. Three types of systems are common as follows :

- i) roadside, communal and stubble grazing
- ii) tethering, and
- iii) cut-and-carry feeding.

The three are not mutually exclusive. Grazing on roadsides and on communal (waste) land may be practised by landless stock owners as well as others when their privately owned lands are under arable crop cultivation. Grazing in rice fields is restricted to periods immediately after harvest when the feeds available consist of the aftermath of the rice crop (viz. rice stubble and some regrowth from the stubble), any weeds which grow in the paddies, the grasses that are found on paddy bunds, and browse from shrubs and trees that grow in it. Where multiple cropping is practised, the crop aftermath may be burnt after the harvest and stubble grazing may be severely restricted or non-existent.

Tethering is adopted when there is a need to prevent animals wandering into areas being cropped and also to ensure that they graze down the available feed in a given area before they are moved. This type of confinement feeding is most popular in South East Asia because multiple cropping is very widespread in this region. The animals may be tethering on waste grazing areas close to the farm or on rice fields after harvest to regulate stubble grazing or close to stacks or rice straw to allow self-feeding.

In the cut-and-carry system a large proportion of the feed is usually brought in from outside the holding because of the small size of holdings in relation to the number of animals kept. The system is subject to the vagaries to seasonal abundance and shortage of forage that characterise it. Since the livestock are housed most of the time, this results in a growing dependence on high priced concentrate feeds during lean periods.

The system together has had limited success because of the value of arable land for food production. This also presents a constraint to forage production for animals. On the other hand, the emphasis on crop production makes available large quantities of crop residues which are valuable as feeds especially to ruminants.

The cut-and-carry or stall feeding system requires high labour and capital investment. It is a system that favours situations where there is no land or more particularly, the availability of abundant supplies of crop residues and agro-industrial by-products. Probably because of the higher capital investment, it has not been adequately used as a system. In Fiji, it has been reported that goats fed sugarcane tops, stovers, straws, coconut cake, rice bran and molasses reached live weight of 23-25 kg in about 22 weeks with a daily live weight gain of 154 g, compared to 83 g in the extensive system (Hussain *et al.*, 1983). Likewise in India, Sehgal and Punj (1983) have demonstrated the value of feeding 80 g NaOH/kg with wheat straw which gave maximum growth rates in growing kids.

On the other hand, where land is available for intensive pasture production, it is feasible to also produce meat or milk from small ruminants. Only limited work that has been done in the Asian and Pacific region in this context, and in order to compare meat production from goat versus cattle, studies have been completed to investigate their response and grazing behaviour to cultivated Setaria setivalva pasture fertilized with 150 kg of N, 40 kg P and 40 kg of K/ha/yr applied in three equal amounts. The average yield of dry matter was about 5-6 tons/ha. Four stocking rates were used: 20, 40, 60 and 80 goats/ha in a randomised block design, replicated thrice, involving Katjang crossbred kids with an initial live weight of about 10-12 kg. At the end of four months, the highest stocking rate rendered the paddock bare and this treatment has to be withdrawn. Table 8 summarises the main trends from the unpublished results (Chen and Devendra, 1984).

The effect on daily live weight gain was dramatic. Noticeable effects were found about three months after the experiment started, and the highest stocking rate only gave a daily live weight gain of 9.2 g/day. Daily live weight gain was significantly correlated to body length ($r = 0.209$, P less than 0.01), height at withers ($r = 0.232$, P less than 0.01) and heart girth ($r = 0.306$, P less than 0.01). The results suggest that the optimum stocking rate for Setaria pastures is about 40 goats/ha.

(Table 8 here)

3. Systems Integrated with Tree Cropping

This system can also be described under the intensive arable system but it merits separate treatment especially in view of the area under tree crops (coconuts, oil palm and rubber) in South and South East Asia and the South Pacific. More particularly, this is also justified by the fact that the system has considerable future potential in increasing production from ruminants (Devendra, 1985a) in view of the expanding hectarage under these tree crops.

This system is especially common in the humid and sub-humid regions where there is intensive crop production. Although the system is not new, integration with these tree crops to ensure more complete utilisation of the land has not been given adequate attention. The advantages of the system are :

- i) Increased fertility of the land via the return of dung urine,
- ii) Control of waste herbage growth,
- iii) Reduced use of weedicides,
- iv) Reduced fertiliser wastage,
- v) Easier management of the crop and
- vi) Distinct possibilities of increases in crop yields, consistent with greater economic including sale of animals and their products.

An additional advantage inherent in the system is the presence of abundant shade offered by the trees. This creates an environment which reduces heat stress on the grazing animals.

Given these advantages, and considering the large area under such tree crop as coconuts, oil palm and rubber in some countries in South East Asia and the Pacific islands, the potential carrying capacity and offtakes of meat (goat meat and/or mutton) from the land is therefore enormous. Many of the Pacific island territories, notably Papua New Guinea, New Hebrides, Fiji, Solomon Islands and Western Samoa, have large land areas under coconuts, implying that there is much potential for integrating goats or sheep into them. Reynolds (1979) has reported the yields for various cultivated grasses and estimated the stocking rates for cattle. On the basis of 3% of body weight (20 kg), the dry matter yield data for the very high, high, medium and low levels of production can support between 64-73, 45-64, 34-45 and 34 goats or sheep/ha respectively which in terms of biomass production must rate very competitively with cattle production.

The potential for this kind of activity is reflected in an estimated area of approximately 20.3 million hectares under tree crops in South and South East Asia (F.A.O., 1984). In Malaysia for example, the combined total hectarage under rubber and oil palm is approximately 4.3 millions. Even if only half of this crop area is utilised by animals, and assuming a carrying capacity of 3 animals/ha, the total number of animal equivalents is of the order of 5.2 million, which is substantial. A specific example of the economic benefits of integrating goats with oil palm concerns the case history of an oil palm estate which allocated a portion of the grazing land within the estate to the workers for grazing their animals. For the first two years (1980 and 1981), only cattle were owned and grazed, but in the years 1982 and 1983 goats were also introduced in addition to cattle. This was done in view of their economic importance and capacity to supply of both meat and milk in the estate.

The comparison of the grazed area and non-grazed area involving both young and mature trees is valid in that it involved the same area of 71-135 ha, and more particularly, the fact that both areas were of the same soil type. The total cattle and goat populations were both about 80 and 220 animals respectively. It can be seen in Table 8 that the differences in yield over the four years in favour the effect of grazing cattle and goats was 2.15 - 5.16 mt fresh fruit bunches/ha/yr with a mean value of 3.51 mt of fresh fruit bunches/ha/yr. When translated into the total hectarage grazed and sale value per ton of fresh fruit yield, the economic advantage is conspicuously substantial. The result in economic terms is similar to the findings in West Java of integrated goats and sheep with rubber (Table 9).

(Table 9 here)

The presence of legumes is of definite advantage, and it has been calculated that the amount of N utilised by the animal and also excreted in the faeces and uring increases with increasing presence of the legume cover (Table 10).

(Table 10 here)

VII FUTURE TRENDS IN PRODUCTION SYSTEMS

In cognisance of the prevailing patterns of animal production, and the resources currently being used to support them, it has been concluded that ruminant production systems are unlikely to change (Mahadevan and Devendra, 1985). It is the view of these authors that major shifts in resource use would be difficult to achieve unless returns from the new systems proposed are demonstrably superior. Changes must therefore, be introduced gradually and must ensure income stability and low risk. The principal aim should be to make maximum use of the basic feed resources available, which is essentially crop residues and/or low quality roughiages. In addition, delivery systems should be developed for the essential supplementary feeds (leguminous forages, agro-industrial by-products or other feed concentrates).

VIII CONSTRAINTS TO THE PRODUCTION SYSTEMS

There are several critical constraints to the prevailing small ruminant production systems. It is essential to briefly discuss and keep these in perspective. It is important to stress that although individual constraints are identified, almost all of them are inter-related and thus have a variable effect on the production systems. Of these, the ecological constraints are largely uncontrollable, but their effects on the environment, and especially on the biological components such as animals and feeds are significant. It is therefore more pertinent to consider the latter aspects. Sometimes one constraint can dominate the presence of others. Feeding and nutrition for example, can override the influence of reproductive efficiency and disease status of goats and sheep. The effects due to the latter are less when nutrition is adequate.

1. Goat and Sheep Resources

There exist a reservoir of valuable indigenous goat and sheep resources that are widely adapted to the climatic extremes found in Asia. The adaptational characteristics are unique to the environment within which they perform a host of very valuable functions. Unfortunately however, and while considerable advances have been made to identify and describe the majority of these breeds (Acharya, 1982; Devendra and Burns, 1983; Hasnain, 1985), their potential productive capacity have not been adequately investigated. Thus in many instances, while the adaptational and functional values are apparent, their genetic potential remains largely unknown.

A major reason for this situation are the limitations on productivity imposed by the other constraints, notably feeding and nutrition, management, diseases and health. Additionally, there are inadequate development policies and support services which can also enhance increased productivity.

2. Feed Resources

The overriding constraint in the production system is feed (Devendra, 1986). There are two aspects to the problem. Firstly, there is the issue of increasing the efficiency with which the available feeds are utilised. These include forages, crop residues, agro-industrial by-products and non-conventional feeds. It is suggested that prevailing feeding systems and the manner with which the feeds are used are inefficient, with the result that the productivity from both species is also low. Substantial improvements to feeding systems are therefore necessary in the quest to maximise productivity from small ruminants.

The second continuing problem is the inability to make maximum use of the total feed resources. Non-conventional feeds, which include several types of tree leaves, for example, are presently underutilised, despite the availability annually, of approximately 194×10^6 tonnes in Asia and the Pacific (Devendra, 1985b). It is significant to note that this total, about 93% of the feeds are suitable for feeding to ruminants.

3. Management

Poor husbandry practices drastically reduce the response from goat and sheep and therefore their productivity. Conversely, the effects of improved feeding and management on performance are spectacular and is seen in the results reported in goats in Malaysia (Devendra, 1979) and goats in India (Sachdeva *et al.*, 1979; Parthasarathy, Singh and Rawat, 1983). In Fiji, improved husbandry, feeding, disease control and breeding has been shown to increase the annual rate of reproduction from 120 to 180%, and well fed does to produce their first kid in in 12-13 months age (Hussain *et al.*, 1983). This is therefore an area that merits very much more attention than in the past in all types of integrated systems involving crops and animals indicated in Table 6.

4. Diseases and Health

The wastage due to disease represents a source of major economic loss in goats and sheep. These losses are of three categories :

- (a) Lowered resistance, caused by undernutrition and malnutrition resulting in deaths due to various diseases.
- (b) Parasitism due mainly to roundworm infestation is a major cause of loss throughout the tropics and is associated with poor nutrition and reduced resistance.
- (c) Transmissible diseases such as coccidiosis and caseous lymphadenitis and pneumonia are serious, cause high mortality and necessitate disease monitoring, appropriate prophylactic measures and/or vaccination.

Goats appear to be more susceptible to gastrointestinal parasitism than sheep. In Bangladesh, for example, 82.2% of 214 kids born died within six months of age, of which respiratory disorders, gastrointestinal parasitism and contagious ecthyma were the main causes. In adults, 47.8% mortality was recorded for gastrointestinal parasitism and respiratory disorders (Abdur Rahman, Ahmad and Mia, 1976). Likewise in Sri Lanka, kid mortality from 2340 pregnancies was reported to be 28% (Ranatunga, 1971).

5. Products from goats and sheep

The inefficiencies that are apparent in the production systems result in the relatively low contribution from the species in terms of especially meat, fibre and skins. This situation is consistent with the view that production of these commodities remains primarily a traditional enterprise. There is very limited commercial production of these same products especially for markets such as in the Near East where there is a growing and large market preference for goat meat and mutton.

Clearly, improvements are necessary to the production process and include inter alia better use of the production resources (land, labour and capital), incentives, credits, transportation and market outlets. In these context, there is need for cost-effective commercial small ruminant production enterprises that can demonstrate the application of known technology and potentially profitable innovations. Such demonstrations have the effect of producers investing in the enterprises.

6. Methodology

An additional constraint that is clearly an important prerequisite for efficient small ruminant production systems is methodology. This needs to be of a type that can be applied successfully and which can further stimulate expansion in small ruminant production.

This is especially the case with mixed crop small ruminant systems such as those that have been described in Table 6. If improvements are to be made within the totality of small farm systems in Asia where mixed crops and animal systems are characteristic, an understanding of the prevailing farming systems and the requirements of the extension approach are essential. De Boer (1985) suggests four consecutive stages : descriptive or diagnostic stage, design stage, testing stage and the extension stage.

IX CONCLUSIONS

Small ruminant production systems in South and South East Asia and the South Pacific are primarily traditional systems. Within these, goats and sheep occupy a secondary position in the complexity of small mixed farms. The prevailing lack of incentives, and more particularly, inadequate application of innovations suggest that a

significant expansion in the productivity from goats and sheep is unlikely if the present trends are allowed to continue. Improvements are therefore urgently necessary which can efficiently use the production resources in systems that are demonstrably superior and potentially profitable.

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TABLE 1

THE GOAT AND SHEEP RESOURCES OF SOUTH AND SOUTH EAST ASIA
AND THE SOUTH PACIFIC (F.A.O., 1984)

Species	Population (millions)	As % of population in Asia ⁺	Rate of growth/yr (%) (1974-76 to 1984)	As % of total grazing ruminants in Asia
Goats	136.2	53.4	2.1	12.6
Sheep	73.0	22.9	1.5	6.8

⁺ Goats was 255.2 millions

Sheep was 322.9 millions

TABLE 2

THE RELATIVE CONTRIBUTION OF GOATS AND SHEEP IN
SOUTH AND SOUTH EAST ASIA AND THE SOUTH PACIFIC
 (10³ MT, F.A.O., 1984)

Product	<u>GOATS</u>		<u>SHEEP</u>	
	Production	As % of total production in Asia	Production	As % of total production in Asia
Goat meat	661	54.1	-	-
Mutton	-	-	353	19.8
Goat milk	1,907	53.8	-	-
Sheep milk	-	-	52	1.4
Goat skins ⁺	135,891	57.6	-	-
Sheep skins ⁺	-	-	73,983	20.8
Wool (greasy)	-	-	89,466	19.7

⁺ Actual production (fresh)

TABLE 3

THE PERCENTAGE OF THE INDIGENOUS PRODUCTION
OF CARCASS MEAT ACCOUNTED FOR BY GOAT MEAT, MUTTON
AND PER CAPUT SUPPLY IN ASIA (FAO, 1974; 1984)

Period	% of indigenous production ⁺		Per caput goat supply(kg/yr) ⁺⁺	
	Goat meat	Mutton	Goat meat	Mutton
1961-65	5.0	6.0	0.47	0.56
1974	3.9	5.5	0.40	0.56
1984	3.9	5.7	0.44	0.64

⁺ As percentage of beef and veal, mutton and lamb, goat meat, buffaloes meat, pig and poultry meats

⁺⁺ Includes offals.

TABLE 4

IMPORTANT GOAT BREEDS IN SOUTH AND SOUTH EAST ASIA
AND THE SOUTH PACIFIC

Breed	Country	Speciality	Approx. Adult Live weight of female (Kg)
Barbari	India	Milk/Meat/Prolificacy	27 - 35
Beetal	India	Milk	40 - 45
Black Bengal	India	Prolificacy	9 - 15
Damani	Pakistan	Milk	21 - 25
Dera Din Panah	Pakistan	Milk	40 - 42
Fijian	Fiji	Meat	30 - 35
Jamnapari	India	Milk	45 - 60
Kamori	Pakistan	Milk	50 - 55
Katjang	Malaysia/ Indonesia	Prolificacy	22 - 23
Malabar	India	Prolificacy	40
Marwari	India	Milk	25 - 27
Sirohi	India	Meat	50 - 53

TABLE 5

IMPORTANT SHEEP BREEDS IN SOUTH AND SOUTH EAST ASIA
AND THE SOUTH PACIFIC

Breed	Country	Speciality	Approx. Adult Live weight of female (Kg)
Baluchi	Pakistan	Mutton	35 - 40
Chokha	India	Coarse wool	23 - 25
Indigenous	Malaysia	Coarse wool	22 - 24
Indonesia	Javanese thin-tailed	Prolificacy/Mutton	25 - 28
Indonesia	Priangan	Prolificacy/Mutton	27 - 30
Indonesia	East Java fat-tailed	Prolificacy/Mutton	30 - 35
Jaffna	Sri Lanka	Hair	18
Lohi	India	Mutton/Prolificacy	22 - 28
Mandya	India	Mutton	28 - 30
Nellore	India	Mutton	38 - 42

TABLE 6

ESTIMATED SHARE OF SMALL RUMINANT INCOME
OF TOTAL INCOME IN WEST JAVA
(Knipscheer et al., 1983)

Location	No. of Farms Surveyed	Annual Income Per Farm (1980)	Small Ruminant Income (1980)	Small Ruminant Income as % of total Income
Cerebon (Lowland)	79	220 000	37 593	17.1
Ciburuy (Rubber Plantations)	66	180 000	46 671	25.9
Garut (Upland)	135	300 000	41 466	13.8

TABLE 7

TYPES AND CHARACTERISTICS OF FARM SYSTEMS INVOLVING SMALL RUMINANTS IN ASIA

Type of farm system	Cropping pattern	Type of ruminants ⁺	Small Ruminant Production objective	Average size of goat and sheep flocks	Current Importance ⁺⁺
Crops	Rice	B,C	Goat meat/mutton	1 - 5	Low
Crops	Mixed Rice-maize*	C,B,G,S	Goat meat/mutton	1 - 5	Low
Crops	Mixed Rice-wheat	C,B,G,S	Goat meat/mutton/milk	10 - 30	Medium/low
Crops	Mixed Rice	B,C,G,S	Goat meat/mutton	1 - 5	Low
Crops	Wheat	C,B	Goat meat/mutton/milk	10 - 30	Medium/low
Crops	Wheat-rice	C,B	Goat meat/mutton	10 - 30	Medium/low
Crops	Coconuts	G,S	Goat meat/mutton	10 - 40	Medium/low
Crops	Oil Palm	B,G,S	Goat meat/mutton	8 - 30	Medium/low
Crops	Rubber	C,G,S	Goat meat/mutton	8 - 30	Medium/low

⁺ B = Buffaloes, C = Cattle, G = Goats, S = Sheep

⁺⁺ Based on average ownership by small farmers, landless labourers and peasants.

* Mixed crops refer to root crops, oil seeds, cash crops, vegetables and also fodders

TABLE 8

EFFECTS OF STOCKING RATE ON THE PERFORMANCE OF GOATS
GRAZING *Setaria Sphacelata* VAR. *Splendida* PASTURES

Parameter	Goats/ha			
	20	40	60	80
Mean live weight gain (g/day)	43.2	41.2	29.0	9.2
Body length (cm)	103.3	102.5	99.4	99.3
Height at withers (cm)	53.2	53.2	52.0	51.1
Heart girth (cm)	59.1	59.5	57.7	56.4
Grazing time (min)	416.4	434.0	454.6	460.7
Resting time (min)	82.0	79.5	51.0	54.1
Distance walked (m)	852.1	664.4	813.3	801.3

TABLE 9

THE EFFECT OF MIXED CATTLE AND GOAT GRAZING ON THE YIELD OF
FRESH FRUITS IN OIL PALM CULTIVATION IN MALAYSIA (Devendra, 1985a)

Year	Grazed area (Yield of fresh fruit bunches/ha/yr, mt)	Non-grazed area (Yield of fresh fruit bunches/ha/yr, mt)	Difference (fresh fruit bunches ha/yr, mt)
1980	30.55 (C) ⁺	25.61	4.94
1981	17.69 (C) ⁺	15.87	1.82
1982	25.12 (C + G) ⁺⁺	22.97	2.15
1983	23.45 (C + G)	18.29	5.16
Mean	24.20	20.69	3.51

⁺ C = cattle

⁺⁺ C + G = cattle + goats

TABLE 10

UTILISATION OF THREE SYSTEMS OF GROUND VEGETATION BY
INDIGENOUS SHEEP UNDER RUBBER IN MALAYSIA
 (Chee and Devendra, 1981)

System	Vegetation	Dry Matter (kg/ha)	Crude Protein %	Crude Protein [-----]	N Content (kg/ha)	N Retained ¹ (kg/ha)	N Unutilised (kg/ha)
1	Natural cover	500	11.4	57	9.1	0.5	8.6
2	Natural cover and legumes	1400	15.0	210	33.6	1.6	32.0
3	Pure legumes	2600	24.4	619	99.0	4.9	64.4

¹A 70% digestibility of crude protein and a 7% retention of nitrogen by the grazing animal is assumed.